DE 101 29 227 A1 (ENGLISH TRANSLATION)

PTO 06-6682

CY=DE DATE=20020314 KIND=A1
PN=101 29 227

SHAPED CHARGE
[Hohlladung]

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UNITED STATE PATENT AND TRADEMARK OFFICE
Washington, D.C September 2006

Translated by: FLS, Inc.

PUBLICATION COUNTRY	(19):	DE
DOCUMENT NUMBER	(11):	101 29 227
DOCUMENT KIND	(12):	A1
PUBLICATION DATE	(43):	20020314
APPLICATION NUMBER	(21):	101 29 227.9
DATE OF FILING	(22):	20010619
ADDITION TO	(61):	
INTERNATIONAL CLASSIFICATION	(51):	F42B 1/032
PRIORITY	(30):	July 19, 2000 100 35 397.5
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APPLICANT	(71):	DAIMLER-CHRYSLER AG
DESIGNATED CONTRACTING STATES	(81):	
TITLE	(54):	SHAPED CHARGE
FOREIGN TITLE	[54A]:	HOHLLADUNG

Specification

[**0001**] The invention relates to a shaped charge with a liner which has two different materials, the first material nearer the main axis of the shaped charge being chosen from a first group of those materials which have high perforation performance and the average opening angle in the region of the first material being smaller than the average opening angle in the area of the other material.

[**0002**] Different version of liners for shaped charges is known which can contribute to improving the perforation performance of the shaped charge in the target.

[**0003**] DE 35 08 749 C2 describes by way of example a shaped charge used as a bore charge of a tandem round. Copper with an acute cone angle of the liner of 60° has proven itself as the material for the liner. Furthermore it has been suggested that instead of copper, other metals be used which are able to afterburn in air. With the intention of producing a crater as large as possible, this document suggests an opening angle from 90° to 110°, and the thickness of the magnesium liner should be roughly five times the conventional copper liner. The objective of producing a large crater diameter is achieved using a particle jet which widens in a bell-shape. The result is a trumpet-shaped crater washed free of fragments in which the follow-on charge can develop its action.

[**0004**] In the indicated shaped charge, penetrating through a stable wall of a target and developing a secondary action with the same charge behind the wall are not important. The exothermal properties of the proposed liner are not used according to the proposals in the indicated document.

[0005] DE 36 22 680 A1 discloses a shaped charge with an liner which has two different materials according to the preamble. This liner consists of two sections, of which the head-side, acute-angle section forms a thin leading jet and the base-side, high mass and roughly right-angle liner forms a wider trailing main jet. For the material of the head-side liner, nickel has been proposed, and for the base-side liner, copper or tantalum. There is no indication of the utility of materials with other properties as the perforation performance.

[0006] The object of the invention is to devise a configuration of a shaped charge and a process for producing a shaped charge spike which with only one shaped charge develops both perforation performance and also blast performance.

[0007] The object is easily achieved by the features of the device shown in Fig. 1 and the features of the process given in Claim 3. Advantageous versions of the invention are described in the subordinate claims.

[0008] The special advantage of the invention consists in achieving a secondary action which can be determined before use without using a follow-on charge. Therefore this shaped charge is especially suited for use again targets which have a certain minimum outside wall thickness and in which after penetration of the steel wall a blast action is to be achieved in the interior. In this connection, an interaction of the generated spike with the wall and/or the bottom of the target crater is advantageously used.

[0009] Embodiments of the invention are shown schematically simplified in the drawings and are detailed below.

[0010] Figure 1 shows a shaped charge with a staggered liner,

[**0011**] Figure 2 shows a shaped charge with a continuously opening liner.

[**0012**] Figure 3 shows a shaped charge with a staggered liner and a core for guiding the detonation wave.

[**0013**] Figure 1 shows a section through a shaped charge which contains an explosive charge **2** within a housing **G**. In the conical recess of the explosive charge **2** there is a spike-forming liner **1a, 1b** which widens with an opening angle α toward the outer edge of the shaped charge. Generally the opening angle α is located rotationally symmetrical to the main axis **A** of the shaped charge. A shaped charge of the previously described type is suited to penetrating the target wall which corresponds to the shaped charge performance by means of the spike which forms when the explosive charge ignites. After this primary perforation process, behind the perforated wall there is no longer any noteworthy secondary blast action delivery (pressure and temporary increase). If the opening angle α is enlarged, the perforation which can be achieved in the target widens to a crater, and a blast action is achieved to an equally small degree.

[**0014**] As claimed in the invention, the spike-forming liner is made in at least two parts. The ratio of its size portions is characteristic of the ratio between the perforation performance and blast performance in the target. In the embodiment the portions **1a, 1b** of the liner are chosen such that they do not greatly deviate from one another in terms of magnitude. But the materials used are different. The first liner 1s which is located in the area of the main axis is selected from that group of materials which are characterized by high perforation

performance (for example, copper). At the same time, this first part of the liner has an opening angle α which is small or acute compared to the remainder of the liner. Typically, this angle is in the range between 40° and 60°. The combination of the liner material and the acute opening angle together with conventional central triggering by means of an only suggested detonator **z** produces a sharply focussed spike which leads all other spike components and which is especially suited for perforation of the target wall. Steel armor is assumed to be the material of the target wall here. The spike for conventional dimensioning of the liner has a diameter of roughly 5 mm and produces a crater of up to 20 mm diameter in the target wall. Basically it is sufficient to bore the wall of the target except for a remaining wall residue.

[**0015**] With a certain delay the other part of the liner 1b which has a larger opening angle α is formed into a particle jet. This opening angle is typically in the range from 50° to 90°. The particle jet produced therewith is however not as sharply focussed as the spike formed from the first part of the liner 1a, and it trails the high-speed leading spike portion. The second or if necessary also one or more other liners 1b following to the outside consists of a material from that group of lightweight metals or their alloys which are characterized by special reactivity with oxygen. Magnesium and aluminum or an alloy containing portions of both are especially well suited to this purpose. A magnesium-aluminum alloy (Mg Al 19 Zn1) has proven especially effective in tests. The trailing particle jet has a diameter of 20-30 mm which is thus on the same order of magnitude as the crater produced before, and it penetrates the remainder of the

steel armor wall. In this connection, an interaction of the particle jet with the remainder of the steel wall and also with the wall of the opening bored into the target occurs. This interaction is expressed in an enormous pressure and temperature increase behind the target wall, a so-called blast effect occurs. For a pure aluminum liner an increase of the blast performance can be ascertained. In the aforementioned MgAl alloy the greatest blast effect to date has been measured in an steel armor target. In this connection it is not decisive whether the immediate vicinity of the target contains enough atmospheric oxygen. It can be assumed that enough oxygen is entrained in the suction of the spike.

[**0016**] The attainable blast effect lies in increasing the pressure behind thy target wall to a few bars and in the temperature increase based on the reaction with atmospheric oxygen to values up to 100°-150°C. It happens in this connection that the ratio between the perforation and blast performance can be influenced for example by the ratio of the volumetric portions and material selection of different liners. It is also possible to influence the performance of the spike-forming liners 1a, 1b by a corresponding choice of the thickness of the respective liner.

[**0017**] In addition to the biconical shape of the shaped charge liner shown in Fig. 1, also other shapes of the opening angle α are possible. Figure 2 shows a funnel-shaped configuration of the shaped charge liner **1a, 1b** with a continuously rising angle α proceeding from the main axis **A** of the shaped charge or one which opens to the outside according to the shape of a geometrical curve.

[**0018**] Figure 3 suggests other possibilities for influencing spike

formation. After ignition of the detonator **Z** which is centrally located in this figure, the detonation waves propagate axially therefrom until they hit the inert means **D** supported in the explosive charge for detonation wave guidance and are rerouted there in radial directions. Especially the time interval of the successive spike portions can be influenced by way of the running time and direction of the detonation waves. It is likewise easily conceivable to trigger the explosive charge by way of off-center detonators **Z** which are initiated at suitable times and thus to achieve matching to different target properties and corresponding optimization of the attainable performance.

Claims

1. Shaped charge with a liner which has two different materials, the first material (1a) nearer the main axis (A) of the shaped charge (HL) being chosen from a first group of those materials which have high perforation performance and the average opening angle (α) in the region of the first material (1a) being smaller than the average opening angle in the area of the other material (1b), characterized in that the other material (1b) farther away from the main axis (A) of the hollow charge (HL) is selected from the group of lightweight metals or their alloys which form a strong reaction with oxygen.

2. Shaped charge as claimed in Claim 1, wherein the intensity ratio between the leading spike portion which yields the perforation performance and the trailing particle jet which causes the blast action can be adjusted using the location of ignition initiation (Z) and/or by means (D) provided in the region of the explosive change (2) of the shaped charge (<u>HL</u>) for guiding the detonation wave.

3. Process for producing a shaped charge spike with secondary action using a liner which has two different materials, the first material (1a) nearer the main axis (A) of the shaped charge (HL) being chosen from a first group of those materials which have high perforation performance and the average opening angle (α) in the region of the first material (1a) being chosen to be much smaller than the average opening angle in the area of the other material (1b), wherein by means of at least one other part of the spike-forming liner of the shaped charge, with a material (1b) selected from the group of lightweight metals or their alloys which form a strong reaction with oxygen, a trailing particle jet with high blast action is formed.

4. Process for producing a shaped charge spike as claimed in Claim 3, wherein a blast effect is achieved by means of the trailing particle jet based on the interaction with the target material, especially with steel armor, in the area of the crater produced by the leading spike portion.

3 pages of drawings attached

FIG.1

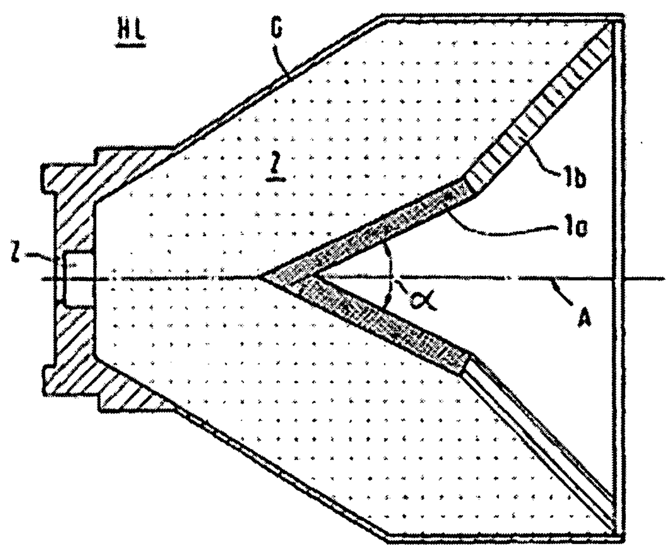

FIG.2

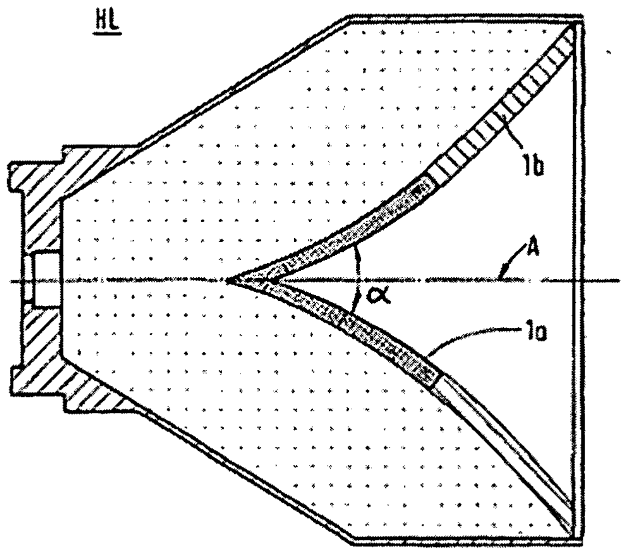

FIG.3